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[Name of Document] Specification 1

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[Name of Document] Abstract 1

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[Title of the Invention] Recording Method, Recording Apparatus and Recording Medium

[Scope of Claims]

[Claim 1]

An image recording method in which, by supplying a liquid on an intermediate transfer member in response to an image signal, a visible image is formed on an intermediate transfer member, and the visible image is then transferred onto a recording medium so as to produce a recorded image, the image recording method being characterized in that:

a layer of a powder is previously formed on the intermediate transfer member, the layer being dissolvable and swellable by the liquid supplied on the intermediate transfer member, enabling a viscosity of the liquid to be increased, and removable from the intermediate

transfer member; and the visible image formed on the intermediate transfer member is then transferred to the recording medium, wherein:

an intermediate transfer medium (hereinafter, referred to as an intermediate transfer element) includes a material having a water-absorbing property relative to an ink and a viscosity-improving property, and an ultraviolet absorbent.

[Claim 2]

The recording method as described in claim 1, characterized in that the ultraviolet absorbent includes at least one absorbent selected from the group consisting of benzophenone-based, benzotriazole-based and triazine-based ultraviolet absorbents.

[Claim 3]

The recording method as described in claim 1, characterized in that the ultraviolet absorbent includes at least one absorbent selected from the group consisting of cerium oxide and titanium oxide.

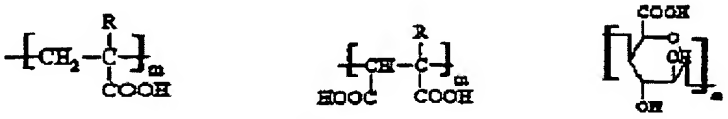
[Claim 4]

The recording method as described in claim 1, characterized in that the intermediate transfer element comprises the ultraviolet absorbent having an amount of from about 0.1 % to 10 % by weight relative to the intermediate transfer element.

[Claim 5]

The recording method as described in claim 1, characterized in that the intermediate transfer element comprises at least one polymer selected from the group consisting of carboxyl groups of the following formula and the crosslinking polymers thereof, and the intermediate transfer element has a salt formed with oleophilic amine;

[Chemical formula 1]



where: R represents hydrogen or an alkyl group represented by R

= C_nH_{2n+1}, and n is 0 or an integer of 1, 2, 3.

[Claim 6]

The recording method as described in claim 1, characterized in that particle diameters of the intermediate transfer element and the ultraviolet absorbent are less than a half of a diameter of the liquid.

[Claim 7]

An image recording apparatus in which, by supplying a liquid on an intermediate transfer member in response to an image signal, a visible image is formed on an intermediate transfer member, and the visible image is then transferred onto a recording medium so as to produce a recorded image, the image recording apparatus being characterized by comprising: a powder mixture layer forming means for uniformly forming a layer of an intermediate transfer element on a surface of the intermediate transfer member, the intermediate transfer element including a powder and an ultraviolet absorbent, the layer being dissolvable and swellable by the liquid on the intermediate transfer member, enabling a viscosity of the liquid to be increased, and removable from the intermediate transfer member; a liquid supplying means for supplying the liquid on the intermediate transfer member on which the powder mixture layer is formed; and a transfer means for transferring the image formed on the intermediate transfer member onto the recording medium.

[Claim 8]

The recording medium characterized in that an image is formed thereon by the recording method as described in any one of claims 1 through 6, or by the recording apparatus as described in claim 7.

[Detailed Description of the Invention]

[0001]

[Field of the Invention]

The present invention relates to a transfer-type inkjet recording method and apparatus in which by causing an ink liquid

to be ejected from a printing head, an ink image is formed on a layer of a transfer element (on an intermediate transfer member), the formed image is then transferred onto a recording medium, and the image in ink is obtained on the recording medium.

[0002]

[Background Art]

A recording method such as an inkjet recording, in which a liquid containing a color agent is used as a droplet to perform recording in response to an image signal, is advantageous because a mechanism is simple and a noise can be reduced to an almost negligible amount. However, there are printing quality problems associated with variations in printing conditions and quality depending on a type of a recording medium. Further, there is another problem that a printed image which is not dried fully is degraded when the recorded medium is ejected.

[0003]

As a recording method designed to solve the above-mentioned problems, U.S. Pat. Nos. 4,538,156 and 5,099,256 propose a so-called intermediate transfer method in which, first an ink image is formed on an intermediate transfer member by an inkjet recording method, and then the ink image on the intermediate transfer member is transferred from the transfer medium to a recording medium.

[0004]

However, in this method, when an ink liquid is printed on the transfer medium, the ink liquid spreads inadequately, flows and mixes, thereby forming an image in inaccurate position or shape. This phenomenon is herein referred to "ink liquid crawling." If this ink liquid crawling phenomenon causes dots to spread inadequately or flow, dot position and shape will then be shifted from an area in which dots needs to be duly formed. And as a result, good print images may not be obtained on the recording medium.

[0005]

In order to solve such problems, Japanese Patent Laid-Open

Publication No. 62-92849 discloses a transfer method in which, first an ink liquid is ejected on an intermediate transfer medium, a large portion of a water content of the ink liquid formed thereon is evaporated to form a condensed ink liquid, which is in turn transferred to a recording medium. This method has an advantageous effect that a vivid image can be obtained, but has further another problem to be solved because this method is not suitable for a high-speed recording because much time is required to obtain the condensed ink.

[0006]

In the invention as described in Japanese Patent Laid-Open Publication No. 3-55283, another method is disclosed, in which an ejected ink provided on an ink transfer member is cooled partially so as to solidify the ink and to achieve a recording. A local cooling of the ejected ink induces a formation of high viscosity of the ink, and thus, the recording is performed. Like Japanese Patent Laid-Open Publication No. 62-92849, the above two methods are not suitable for high-speed printing, since the cooling process is a time-consuming process.

[0007]

Japanese Patent Laid-Open Publication No. Hei 7-145576 discloses a specialized ink with which a printing quality is independent of the type of a recording medium, and a transfer medium from which only an image part is separated. Because transfer based on this type is carried out at temperature of from about 200℃ to about 300℃ as a softening temperature of a separating layer, there is provided a problem of a high-speed recording and system reliability.

[0008]

Moreover, properties such as water resistance and light resistance for a dye-based ink liquid is inferior to that for a pigment-based ink liquid, although images formed by the former have high chroma and vivid color tones. Japanese Patent Laid-Open

Publication No. Sho 54-68303 discloses an ink liquid containing an aqueous organic ultraviolet absorbent. However, this ink liquid causes a clogged recording head problem and another disadvantage in that ejection stability is unsatisfactory for the ink jet recording method in which the ink droplet is ejected.

[0009]

[Problems to be Solved by the Invention]

The present invention is made for the purpose of improving high-speed printing capacity using common paper as a recording medium and light resistance of the image formed on the recording medium, and is directed to provide a new recording method and apparatus based on an intermediate transfer member recording mechanism, in which the recorded medium has no ink blurring or penetration to the background, the transferred images have excellent light resistance and water resistance.

[0010]

[Means for Solving the Problems]

The present invention provides, by employing an intermediate transfer element having a water-absorbing property relative to the ink and showing an increased viscosity, a recording method and apparatus which prevent image blur due to liquid crawling and penetration problems of a transferred image, and further, improve light resistance of the transferred image by containing an ultraviolet absorbent in the intermediate transfer element, and eliminate recording head clogging because of inclusion of the ultraviolet absorbent in the ink liquid.

[0011]

The invention in claim 1 is related to an image recording method in which, by supplying a liquid on an intermediate transfer member in response to an image signal, a visible image is formed on an intermediate transfer member, and the visible image is then transferred onto a recording medium so as to produce a recorded image, and the image recording method is characterized in that:

a layer of a powder is previously formed on the intermediate transfer member, the layer being dissolvable and swellable by the liquid supplied on the intermediate transfer member, enabling a viscosity of the liquid to be increased, and removable from the intermediate transfer member; and the visible image formed on the intermediate transfer member is then transferred to the recording medium, and also characterized in that:

an intermediate transfer medium includes a material having a water-absorbing property relative to an ink and a viscosity-improving property (hereinafter, referred to as an intermediate transfer element), and an ultraviolet absorbent.

[0012]

In the invention as described in claim 1, the invention in claim 2 is characterized in that the ultraviolet absorbent includes at least one absorbent selected from the group consisting of benzophenone-based, benzotriazole-based and triazine-based ultraviolet absorbents.

[0013]

In the invention as described in claim 1, the invention in claim 3 is characterized in that the ultraviolet absorbent includes at least one absorbent selected from the group consisting of cerium oxide and titanium oxide.

[0014]

In the invention as described in claim 1, the invention in claim 4 is characterized in that the intermediate transfer element comprises the ultraviolet absorbent having an amount of from about 0.1 % to 10 % by weight relative to the intermediate transfer element.

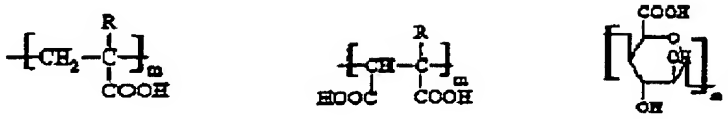
[0015]

In the invention as described in claim 1, the invention in claim 5 is characterized in that the intermediate transfer element comprises at least one polymer selected from the group consisting of carboxyl groups of the following formula and the crosslinking polymers thereof, and the intermediate transfer element has a salt

formed with oleophilic amine;

[0016]

[Chemical formula 1]



where: R represents hydrogen or an alkyl group shown in a formula of $R = C_nH_{2n+1}$, and n is 0 or an integer of 1, 2, 3.

[0017]

In the invention as described in claim 1, the invention in claim 6 is characterized in that particle diameters of the intermediate transfer element and the ultraviolet absorbent are less than a half of a diameter of the liquid.

[0018]

The invention in claim 7 refers to an image recording apparatus in which, by supplying a liquid on an intermediate transfer member in response to an image signal, a visible image is formed on an intermediate transfer member, and the visible image is then transferred onto a recording medium so as to produce a recorded image, and the image recording apparatus is characterized by comprising: a powder mixture layer forming means for uniformly forming a layer of an intermediate transfer element on a surface of the intermediate transfer member, the intermediate transfer element including a powder and an ultraviolet absorbent, the layer being dissolvable and swellable by the liquid on the intermediate transfer member, enabling a viscosity of the liquid to be increased, and removable from the intermediate transfer member; a liquid supplying means for supplying the liquid on the intermediate transfer member on which the powder mixture layer is formed; and a transfer means for transferring the image formed on the intermediate transfer member onto the recording medium.

[0019]

The invention in claim 8 refers to the recording medium characterized in that an image is formed thereon by the recording

method as described in any one of claims 1 through 6, or by the recording apparatus as described in claim 7.

[0020]

[Preferred Embodiments of the Invention]

(Invention in claim 1) The present inventors applied a recording method using an element (intermediate transfer element) having a water absorbing property relative to the ink liquid and an improved viscosity to a recording method and an apparatus using an intermediate transfer member, and achieved a high-quality, high-speed recording of image with reduced image blurring independent of the type of paper in the inkjet recording. The present invention has made an advantageous effect on an improved light resistance of a recording medium by mixing an ultraviolet absorbent with the water-absorbing element which shows the increased viscosity with respect to the ink liquid on the intermediate transfer member.

[0021]

The ultraviolet absorbent mixed with the water-absorbing element can be transferred to the recording medium together with the water-absorbing element expanded with the absorbed ink. A thus-formed image shows an ultraviolet absorbing affect. Accordingly, the image containing the ultraviolet absorbent has good storage stability even under the environment of light irradiation. Since the ultraviolet absorbent is not contained in an ink liquid tank in advance, the recording head clogging due to an aggregation reaction with the ink component can be eliminated, thus leading to an excellent ejection stability of the apparatus.

[0022]

(Invention in claim 2) In the invention in claim 1, when the ultraviolet absorbent has a chemical structure based on benzophenone compounds, benzotriazole compounds and triazine compounds, an ultraviolet ray may effectively be absorbed, thereby achieving light resistance and improved storage stability of the

image. Further, if appropriate, use of a water-soluble material may maintain a very high quality image. In a case of an organic ultraviolet absorbent, there is provided a wider selection of the ultraviolet absorbents because the ultraviolet absorbents suitable for the ink can be prepared. Specifically, examples of the organic ultraviolet absorbents based on benzophanone, benzotriazole and salicylic acid compounds include the following, though not limited to these. For example:
2, 4-dihydroxybenzophenone, 2-hydroxy-4- methoxy- benzophenone,
2-hydroxy-4-octoxybenzophenone,
2-(2'-hydroxy-5'-methylphenyl)benzotriazole,
2-(2'-hydroxy-5'-tert-butylphenyl)benzotrlazole,
phenyl salicylate, p-tert-butylphenyl salicylate, and
p-octylphenyl salicylate. Typical ultraviolet absorbents preferably used in preferred embodiments of the present invention are salts of sulfonic and carboxylic acids of the water-soluble dye. Examples include C. I. Acid Red 27, C. I. Acid Blue 9, C. I. Acid Yellow 23, C. I. Direct Blue 199, C. I. Direct Yellow 86, Food Black 2 or the like.

[0023]

(Invention in claim 3) In the invention in claim 1, when an inorganic ultraviolet absorbent such as titanium oxide and cerium oxide or the like is used as the ultraviolet absorbent, an image having excellent sharpness can be obtained with highly efficient absorption of the ultraviolet rays, thus leading to formation of the image having light resistance and excellent storage stability. In addition, since the inorganic ultraviolet absorbent exhibits excellent heat resistance, this effect in the image is maintained for a long period of time. Furthermore, because the inorganic ultraviolet absorbent is not contained in the ink liquid tank, the recording head clogging due to aggregation reactions with the ink liquid is eliminated, thus leading to excellent reliability and ejection stability of the apparatus.

[0024]

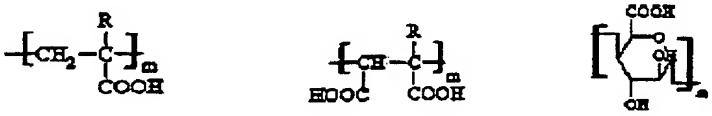
(Invention in claim 4) In the invention in claim 1, inclusion of the ultraviolet absorbent results in enhancement of light resistance and storage stability of the image formed. When a content of the ultraviolet absorbent is less than about 0.1% by weight relative to the intermediate transfer element having an ink liquid-absorbing property, the excellent image stability relative to the light can not be obtained because a sufficient density relative to the colorant is not obtained. On the other hand, when the content of the ultraviolet absorbent is more than about 10% by weight, the stability of the colorant to the light can be obtained, but a quality of the image is degraded. Further, ideally, inclusion of the ultraviolet absorbent having a content of from about 0.1% to about 1% by weight into the ink-absorbing element, results in an excellent image having both high quality and light resistance.

[0025]

(Invention in claim 5) In the invention in claim 1, when the ink liquid includes a colorant based on anionic compounds, a cationic element which reacts with the anionic colorant is preferably used. An oleophilic aliphatic amine as the cationic element reacts electively with a carboxylic group of the ink liquid-absorbing element to form a salt, thereby exhibiting moisture resistance, and this amine causes the colorant to be insoluble. Specifically, examples include acrylic acid resin, acrylic acid/methacrylic acid copolymer resin, methacrylic acid resin, malelc acid resin, acrylic acid/maleic acid copolymer resin, as shown in the chemical formula 3 below.

[0026]

[Chemical formula 3]



where: R represents hydrogen or an alkyl group shown in a formula of R = C_nH_{2n+1}, and n is 0 or an integer of 1, 2, 3.

[0027]

Further, representative examples of useable high water-absorbing polymeric materials include: polyalkyl oxide such as polyethylene oxide, polyvinyl pyrrolidone, polyvinyl alcohol, polyvinyl butyral, polyacrylamide, polypropylene glycol, glue, gelatin, casein, albumin, alginic acid, alginic soda, methyl cellulose, carboxymethyl cellulose, hydroxyethyl cellulose, polyvinyl ether, polyvinyl methyl cellulose, polyethylene glycol, glucose, xylose, sucrose, maltose, arabinose, α-cyclodextrin, starch, copolymers, graft copolymers, crosslinking polymers thereof, or other suitable materials. Examples of aliphatic amines preferably used include: laurylamine, stearylamine, dodecylamine, rosinamine, diamylamine, triallylamine. Specifically, laurylamine, polyallylamine, tributylamine, diamylamine, triallylamine, or other suitable materials are used, but not limited to these materials.

[0028]

(Invention in claim 6) In the invention in claim 1, when particle diameters of the intermediate transfer element having water-absorbing property and an improved viscosity are less than a half of a diameter of the ink liquid, the ink-absorbing element (intermediate transfer element) achieves excellent contact with the ink liquid because of a large surface area. This enables the intermediate transfer element to react with the liquid rapidly, so that a viscosity of the liquid is increased and the image having excellent resolution can be obtained. Further, the particle diameter of the ultraviolet absorbent less than that of the ink-absorbing element, uniform mixture is enabled, and the image quality is maintained. When the ink-absorbing element has a too large diameter, resulting in a poor contact with the ink liquid, so that the viscosity of the liquid is not increased instantaneously.

This induces inaccuracy of the image position on the intermediate transfer member. Conversely, if the particle diameter of the intermediate transfer element is too small, the quantity of coating may not effectively be controlled so that quality of the transferred image is deteriorated.

[0029]

(Invention in claim 7) The recording apparatus in claim 7 is capable of performing the recording method as described in claims 1 through 6, and this recording apparatus forms a visible image on an intermediate transfer member by supplying a liquid on an intermediate transfer member in response to an image signal, and then transfers the visible image onto a recording medium so as to produce a recorded image, and the image recording apparatus includes:

a powder mixture layer forming means for uniformly forming a layer of an intermediate transfer element on a surface of the intermediate transfer member, the intermediate transfer element including a powder and an ultraviolet absorbent, the layer being dissolvable and swellable by the liquid on the intermediate transfer member, enabling a viscosity of the liquid to be increased, and removable from the intermediate transfer member;

a liquid supplying means for supplying the liquid on the intermediate transfer member on which the powder mixture layer is formed; and

a transfer means for transferring the image formed on the intermediate transfer member onto the recording medium.

[0030]

(Invention in claim 8) The invention in claim 8 refers to the recording medium characterized in that an image is formed thereon by the recording method as described in any one of claims 1 through 6, or by the recording apparatus as described in claim 7.

[0031] (Exemplary Embodiment)

Fig. 1 is a general configuration of an apparatus for

explaining an embodiment of a recording apparatus method and apparatus according to the present invention. First, an ink liquid is supplied in response to an image signal, to an intermediate transfer belt 12, on an uppermost surface of which an intermediate transfer medium (intermediate transfer element) is formed, with use of an inkjet recording head 11. The intermediate transfer member belt 12 is driven and transported endlessly between three rollers 13, 14 and 15. An image formed by the ink liquid on the intermediate transfer member belt 12 and the intermediate transfer element forming the image can be transferred to a recording medium from a recording medium tray 16, which is transported by feed rollers 17, 18, 19, 20, 21 and registration rollers 22, 23 with an action of a transferring compression roller 24. The recording medium on which the image by the ink liquid and the intermediate transfer medium forming the image has been transferred is discharged to a sheet discharge tray 27 by sheet discharge rollers 25, 26.

[0032]

The intermediate transfer medium and an ultraviolet absorbent contained in an intermediate transfer medium container 28 are coated on the uppermost surface of the intermediate transfer member belt 12 via an auxiliary coating roller 30 whose coating amount is controlled by a coating amount control blade 29, and a coating roller 31.

[0033]

The intermediate transfer medium remaining on the uppermost surface of the intermediate transfer member belt 12 after the image by the ink liquid and the intermediate transfer medium forming the image have been transferred onto the recording medium, is removed by a cleaning roller 32 and cleaning blades 33, 34 as needed, so that the new intermediate transfer medium is re-coated.

[0034]

Embodiment 1 (Embodiment of the invention in claim 1)

Liquid Recording Device: An intermediate transfer type

inkjet printer for recording according to the method as described in claim 1

Recording sheet: Wood-free paper (Ricoh PPC paper).

Intermediate Transfer Element: A mixture of polyacrylic acid (by Hitachi Chemical), an element having water-absorbing and viscosity-increasing ability and ultraviolet absorbent SUMISOPU 90 (by Sumitomo Chemical).

Method for Forming an Image to the Sheet: As shown in Fig. 1 (image forming method), the above-arranged water-repellent intermediate transfer element was coated on the intermediate transfer member, and an image is formed on the common paper.

Evaluation of Light Resistance: An optical density (which will be hereinafter abbreviated to OD) of the printed image was measured to evaluate light resistance. After irradiation for 50 hours by xenon fade meter under the conditions of 35℃, 70% RH (that is, relative humidity), the OD value of the image was re-measured and evaluated.

Results: In comparison with images performed by the conventional inkjet printing on the common paper, good images with water resistance were formed while achieving prevention of ink liquid blurring and liquid penetration problems. In addition, compared to the conventional element without ultraviolet absorbent, the residual OD value of the printed images containing the ultraviolet absorbent was more than 85%, which indicates good light resistance.

[0035]

COMPARATIVE EXAMPLE 1 (Comparative example to the invention in claim 1)

Liquid Recording Sheet: An intermediate transfer type inkjet printer for recording according to the method as described in claim 1

Recording medium: Wood-free paper (Ricoh PPC paper).

Intermediate Transfer Element: Polyacrylic acid with no ultraviolet absorbent was used.

Method for Forming an Image to the Sheet: As shown in Fig. 1 (image forming method), the above-arranged intermediate transfer element was coated on the intermediate transfer member which is a silicone rubber, and an image was formed on the common paper.

Evaluation of Light Resistance: Evaluation was performed in the same way as Embodiment 1.

Results: Although the images were formed with absence of liquid blur under low humidity conditions in comparison with the conventional image forming method, however, a residual OD value of printed images was 70%, thereby leading to bad storage stability.

[0036]

Embodiment 2 (Embodiment of the invention in claim 2)

Liquid Recording Device: An intermediate transfer type inkjet printer for recording according to the method as described in claim 1

Recording medium: Wood-free paper (Ricoh PPC paper).

Intermediate Transfer Element: A mixture of polyacrylic acid as in the embodiment 1 with 1 wt % of the ultraviolet absorbent, DIC-TBS (by Dainippon Ink Chemicals), relative to polyacrylic acid, was used.

Method for Forming an Image to the Sheet: As shown in Fig. 1 (image forming method), the above-arranged intermediate transfer element was coated on the intermediate transfer member which is a silicone rubber.

Evaluation of Light Resistance: Evaluation was carried out in the same way as Embodiment 1.

Results: In comparison with images performed by the conventional inkjet printing on the common paper, good images with water resistance were formed while achieving prevention of ink liquid blurring and liquid penetration problems. In addition, compared to the conventional element containing NO ultraviolet absorbent, the residual OD value of the printed images containing the ultraviolet absorbent was more than 85%, which indicates good light

resistance.

[0037]

COMPARATIVE EXAMPLE 2 (Comparative example of the invention in claim 2)

Liquid Recording Device: An intermediate transfer type inkjet printer for recording according to the method as described in claim 1

Recording sheet: Wood-free paper (Ricoh PPC paper).

Intermediate Transfer Element: Polyacrylic acid as in the embodiment without ultraviolet absorbent was used.

Method for Forming an Image to the Sheet: As shown in Fig. 1 (image forming method), the above-arranged intermediate transfer element was coated on the intermediate transfer member, and an image was formed on the common paper.

Evaluation of Light Resistance: Evaluation was performed in the same way as Embodiment 1.

Results: Although the images were formed with absence of liquid blur under low humidity conditions in comparison with the conventional image forming method, however, a residual OD value of printed images was low, thereby leading to bad storage stability.

[0038]

Embodiment 3 (Embodiment of the invention in claim 3)

Liquid Recording Device: An intermediate transfer type inkjet printer for recording according to the method as described in claim 1

Recording sheet: Wood-free paper (Ricoh PPC paper).

Intermediate Transfer Element: A mixture of polyacrylic acid and 1 wt % of the ultraviolet absorbent, cerium oxide (Nidoraru (made by Taki Chemical Co., Ltd.)), relative to the polyacrylic acid according to the embodiment 1, was used.

Method for Forming an Image to the Sheet: As shown in Fig. 1 (image forming method), the above-arranged intermediate transfer element was coated on the intermediate transfer member which is a silicone

rubber and images were formed on the common paper.

Evaluation of Light Resistance: Evaluation was carried out in the same way as Embodiment 1.

Results: In comparison with images performed by the conventional inkjet printing on the common paper, good images with water resistance were formed while achieving prevention of ink liquid blurring and liquid penetration problems. In addition, compared to the conventional element containing NO ultraviolet absorbent, the residual OD value of the printed images containing the ultraviolet absorbent was more than 85%, which indicates good light resistance.

[0039]

Comparative example 3 (Comparative example of the invention in claim 3)

Liquid Recording Device: An intermediate transfer type inkjet printer for recording according to the method as described in claim 1

Recording sheet: Wood-free paper (Ricoh PPC paper).

Intermediate Transfer Element: Polyacrylic acid as in the embodiment with no ultraviolet absorbent was used.

Method for Forming an Image to the Sheet: As shown in Fig. 1 (image forming method), the above-arranged intermediate transfer element was coated on the intermediate transfer member, and an image was formed on the common paper.

Evaluation of Light Resistance: Evaluation was performed in the same way as Embodiment 1.

Results: Although the images were formed with absence of liquid blur under low humidity conditions in comparison with the conventional image forming method, however, a residual OD value of printed images was low, thereby leading to bad storage stability.

[0040]

Embodiment 4 (Embodiment and comparative example of the invention in claim 4)

Liquid Recording Device: An intermediate transfer type inkjet printer for recording according to the method as described in claim 1

Recording sheet: Wood-free paper (Ricoh PPC paper)

Intermediate Transfer Element: A mixture of polyacrylic acid, oleophilic stearylamine to be used for neutralization and the ultraviolet absorbent, 0, 0.1, 1, 10, and 20 wt% of phenyl salicylate relative to polyacrylic acid, was used.

Method for Forming an Image to the Sheet: As shown in Fig. 1 (image forming method), the above-arranged intermediate transfer element was coated on the intermediate transfer member, and an image was formed on the common paper.

Results: A good storage stability was observed in the images having the ultraviolet absorbent of form 0.1 % to 10 % by weight relative to polyacrylic acid after irradiation by the xenon lamp to the images. Further, compared to the images printed by the conventionally method, liquid blurring and color mixing was improved. When more than 10 wt% of ultraviolet absorbent is used, although the light resistance of the images on the intermediate transfer member is improved, sharpness of the images formed on the transfer medium is degraded, resulting in generation of irregular colors on the image transferred. (See Table 1.)

[0041]

(1) Light resistance evaluation

The OD values of each of the printed images were measured before irradiation. After irradiation for 50 hours under the conditions of 35℃ and 70% RH by xenon fade meter, the OD values of each image were re-measured to estimate light resistance. Each was qualitatively rated as follows:

◎ A residual OD value after irradiation was more than 85%.

○ The residual OD value after irradiation was more than 70%. × The residual OD value after irradiation was less than 70%.

(2) Image evaluation

The sharpness of the images and color mixing of the color boundary portions were evaluated by a visual inspection.

[0042]

Table 1: Evaluation results

Hydrophilic element: ultraviolet absorbent	Sharpness	Irregular color	Light resistance
100:0	◎	◎	×
100:0.1	◎	◎	○
100:1	◎	◎	◎
100:10	◎	○	◎
100:20	○	×	◎

[0043]

Embodiment 5 (Embodiment of the invention in claim 5 and its comparative example)

Liquid Recording Device: An intermediate transfer type inkjet printer for recording according to the method as described in claim 1

Recording sheet: Wood-free paper (Ricoh PPC paper)

Intermediate Transfer Element: As an embodiment of ink-absorbing element to be mixed with the ultraviolet absorbent, a mixture of polyacrylic acid (PAA), oleophilic stearylamine for neutralization of polyacrylic acid and 0, 1, 6 wt% of the ultraviolet absorbent relative to 10 by weight part of oleophilic element, was used. As a comparative example, sodium of polyacrylic acid (PAS) was used. The oleophilic stearylamine to be used for neutralization, was contained in an amount of 0 and 2% by weight relative to 10 by weight portion of oleophilic element.

Method for Forming an Image to the Recording Medium: As is shown in Fig. 1 (image forming method), the above-arranged intermediate transfer element was coated on the intermediate transfer member made of silicon rubber, and images were formed on the common paper.

Evaluation of Light Resistance: Evaluation was made in the same

way as Embodiment 1.

Results: When a ratio of the salt was present in an amount of from 10 wt % to 50 wt %, a good storage stability of the intermediate transfer element was observed even under humid conditions, and there were no bad effects in forming the images. Further, the images showed improved water resistance while eliminating liquid blurring and liquid penetration problems, as compared to the images printed by means of the conventional method. When the above ratio was more than 60 wt %, although humidity resistance of the intermediate transfer element and light resistance of the formed images were improved, the improvement of sharpness of the images was not observed. When using the sodium of polyacrylic acid as the intermediate transfer element, the liquid images quality was deteriorated on the intermediate transfer member. (See Table 2.)

[0044]

[Table 2] Evaluation results

Hydrophilic element : oleophilic element	Storage stability under humid environment	Sharpness	Light resistance	Water resistance
PAA10 : 0	△	◎	◎	×
PAA10 : 1	○	◎	◎	○
PAA10 : 6	◎	△	◎	◎
PAA10 : 0	×	×	◎	×
PAA10 : 2	×	×	◎	×

[0045]

Embodiment 6 (Embodiment of the invention in claim 6)

Liquid Recording Device: An intermediate transfer type inkjet printer for recording according to the method as described in claim 1 (Dameter of the liquid: 100 μm)

Recording sheet: Wood-free paper (Ricoh PPC paper)

Intermediate Transfer Element: A mixture of polyacryric acid having a particle diameter of 5 μm as the oleophilic element in the

Embodiment 1 and cerium oxide having a particle diameter of 5 μm as the ultraviolet absorbent is used.

Method for Forming Image to the Sheet: As is shown in Fig. 1 (image forming method), the above intermediate transfer element was coated on the intermediate transfer member which is a silicone rubber, and images were formed on the common paper.

Evaluation of Light Resistance: Evaluation was performed in the same way as Embodiment 1.

Results: In comparison with the conventional element which does not contain the ultraviolet absorbent, the obtained printed images showed a good residual OD value of more than 85% and an excellent light resistance property. Further, the formed images were with no ink liquid blurring and liquid penetration problems in comparison with the conventional ink jet images printed on the common paper. Furthermore, the images having excellent sharpness were obtained.

[0046]

Comparative example 6 (Comparative example of the invention in claim 6)

Liquid Recording Device: An intermediate transfer type inkjet printer for recording according to the method as described in claim 1 (liquid diameter: 100 μm)

Recording sheet: Wood-free paper (Ricoh PPC paper)

Intermediate transfer element: As the hydrophilic element in Embodiment 1, a mixture of polyacryric acid having a particle diameter of 60 μm and 2,4-hydroxybenzophenone having a particle diameter of 60 μm as the ultraviolet absorbent was used.

Method for Forming an Image to the Sheet: As shown in Fig. 1 (image forming method), the above-arranged intermediate transfer element was coated on the intermediate transfer member made of silicon rubber, and an image was formed on the common paper.

Evaluation of light resistance: Evaluated similarly to the case of Embodiment 1.

Results: Showed a good light resistance compared to the conventional inkjet images, however, image blurring was occurred on the intermediate transfer member and a good image was not obtained compared to the conventional printing method.

[0047]

[Effects of the Invention]

According to the invention in claim 1, in comparison with the conventional method, blurring of the liquid in the common paper may drastically be prevented, and images with good sharpness may be obtained. Further, storage stability of the image against the light is improved.

[0048]

According to the invention in claim 2, in the invention as described in claim 1, since ultraviolet rays are effectively absorbed by the organic ultraviolet absorbent, images with an excellent light resistance may be obtained. Various types of ultraviolet absorbent are provided, therefore, a suitable material for the type of die may effectively be selected.

[0049]

According to the invention in claim 3, in the invention as described in claim 1, since ultraviolet rays are effectively absorbed by the inorganic ultraviolet absorbent, images with an excellent light resistance may be obtained. The ultraviolet absorbent has an excellent stability against heat.

[0050]

According to the invention in claim 4, in the invention as described in claim 1, formed images show good storage stability against light owing to the ultraviolet absorbent, and owing to the ink-absorbing agent, high quality images may be obtained in comparison with the conventional print method. Both effects are most effectively exerted.

[0051]

According to the invention in claim 5, in the invention as

described in claim 1, the hydrophilic element mixed with the ultraviolet absorbent shows good effects on the storage property in the humid environmental condition and also is effective to the reproducibility of the formed image.

[0052]

According to the invention in claim 6, in the invention as described in claim 1, the amount of the intermediate transfer element is less than 1/2 of that of the ink liquid, whereby image with good light resistance may be obtained without image resolution corresponding to the resolution of the apparatus being deteriorated.

[Brief Description of the Drawings]

[Fig. 1]

Fig. 1 is a general configuration of an apparatus for explaining one embodiment of the recording method and apparatus according to the present invention.

[Reference Numerals]

11 Recording head
12 Intermediate transfer belt
13, 14, 15 Rollers
16 Recording medium tray
17, 18, 19, 20, 21 Feed rollers
22, 23 Registration rollers
24 Transferring compression roller
25, 26 Sheet discharge rollers
27 Sheet discharge tray
28 Intermediate transfer medium container
29 Coating amount control blade
30 Auxiliary coating roller
31 Coating roller
32 Cleaning roller
33, 34 Cleaning blade